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IMMEDIATE WATER POLLUTION CONTROL NEEDS, THE EASTERN SHORE OF DELAWARE, MARYLAND AND VIRGINIA

Federal Water Pollution Control Administration
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TABLE OF CONTENTS

		Page
I.	INTRODUCTION	I - 1
	A. Purpose and Scope	I - 1
	B. Authority	I - 2
	C. Acknowledgements	I - 3
II.	GENERAL	II - 1
	A. Sources of Information	II - 1
	B. Determination of Needs	II - 2
III.	SUMMARY AND CONCLUSIONS	III - 1
	A. Findings	III - 1
	B. Summary of Immediate Needs	III - 4
	1. Waste Treatment	III - 4
	2. Special Studies	III - 5
	3. Institutional Practices	III - 18
IV.	BASIN DESCRIPTION	IV - 1
	A. Area and Population	IV - 1
	B. Water Use and Hydrology	IV - 3
	C. Economy	IV - 5
V.	RECENT PROGRESS IN POLLUTION CONTROL	V - 1
VI.	IMMEDIATE POLLUTION CONTROL NEEDS	VI - 1
	A. General Needs	VI - 1
	1. Waste Source Inventory and Data Compilation	VI - 1
	2. Field Studies	VI - 2
	3. Sewer Districts	VI - 3

TABLE OF CONTENTS (Continued)

		Page
B.	Area Needs	VI - 4
	1. Atlantic Coast Drainage of Maryland	VI - 5
	2. Atlantic and Chesapeake Bay Drainage of the Virginia Peninsula	VI - 8
	3. Northeastern Chesapeake Bay Area, Stump Point (Susquehanna River) to Swan Point (Chester River), Maryland	VI - 10
	4. Chester River Basin	VI - 13
	5. Eastern Bay Drainage	VI - 14
	6. Choptank River Basin	VI - 15
	7. Nanticoke River Basin	VI - 18
	8. Wicomico River Basin	VI - 20
	9. Little Annemessex River	VI - 23
	10. Pocomoke River Basin	VI - 23
VII.	INSTITUTIONAL ARRANGEMENTS	VII - 1
VIII.	BIBLIOGRAPHY	VIII - 1

I. INTRODUCTION

A. Purpose and Scope

The Eastern Shore is a land America almost left behind. Until Chesapeake Bay was crossed by the Bay Bridge in 1951, the Shore was a farming and fishing area with many watermen and farmers with three to six generations of ancestors on the land or waterfront; their clannish independence, industry and strong adherence to tradition were akin more to rural America of 100 years ago than to a modern industrial society.

Today the small farmers and watermen have lost their dominance of the area economy. Farms have modernized and become large, and the very survival of the watermen depends on their changing their methods and attitudes.

" . . . . . They are dying now
Or being educated, which is the same.
One need not weep romantic tears for them,"

But when they are gone -

"Something will pass that was American
And all the movies will not bring it back."[2]

The Eastern Shoremen now have the opportunity of accepting industrial development while retaining the best of their traditional way of life, an opportunity not available to any other comparably sized area on the East Coast. Already, however, the recent growth of modestly-sized metropolitan areas has given the Eastern Shore the same type of problems (if not of the same intensity) as those

of conventional metropolitan industrial areas. At the same time, the existing rural population and industry, increasing development of the shoreline, and the need for very high water quality have not allowed the problem of rural pollution to be disregarded.

The purpose of this study is to examine the surface waters of the Chesapeake Bay drainage and the Maryland and Virginia Atlantic Ocean drainage of the Eastern Shore, and to prepare a working document describing the immediate water pollution control action needed in the Area. The principal objective to the investigation and report is to provide the following information based on currently available knowledge and data:

1. Location and magnitude of present water pollution problem areas as determined by interference with water uses specified by the states.
2. Identification of the pollution sources and parties responsible.
3. Outline for an immediate action program to correct existing problems and prevent incipient problems from developing further.
4. Cost estimates for achieving the corrective program.

B. Authority

This report is submitted under the provisions of the Federal Water Pollution Control Act as amended (33 U.S.C. 466 et. seq.) which directed the Secretary of the Interior to develop programs

for eliminating pollution of interstate waters and improving the sanitary condition of surface and underground waters.

C. Acknowledgements

The findings and recommendations in this study are based largely upon information and opinions offered by State and local officials and upon consulting engineers' reports prepared for local governments. This information was supplemented by inspections conducted by personnel of the Chesapeake Field Station. Cooperation of the officials of the State agencies and local governments listed below was invaluable in developing a summary of the immediate water quality control needs:

Delaware Water and Air Resources Commission

Maryland Department of Chesapeake Bay Affairs

Maryland Department of Water Resources

Maryland State Department of Health

Virginia State Department of Health

Virginia State Water Control Board

Cambridge, Maryland

Cecil County, Maryland

Pocomoke City, Maryland

Salisbury, Maryland

Delmarva Advisory Council, an economic development council supported by the three states and the Federal government.

II. GENERAL

A. Sources of Information

Information was secured principally from State agencies and to a lesser extent from officials of local governments and through inspections by members of the FWPCA Chesapeake Field Station staff. No comprehensive body of data was available in summary or report form during this study, except for coliform data in shellfish waters. Considerable field data, however, were available in preliminary form from MDWR, pending later publication of the reports. Qualitative observations solicited from State officials were relied upon where quantitative field data were lacking. The conclusions and recommendations in this study, however, are those of the FWPCA Chesapeake Bay-Susquehanna River Basins Project.

Consultants' cost estimates for municipal construction were used where available. In most such cases, consulting engineers' reports were on file with MSDH, but in several cases proposed action and cost information was transmitted orally by MSDH or local officials. Where consultants' studies were not available, treatment plant costs were estimated from average national costs,[7] except in the case of small plants for communities of less than 2,500 population. For such construction, an average per capita cost was computed from consulting engineers' studies[16-18,24,26,27-29] and applied to the town population. Construction costs of sewers were also estimated in this way.

The costs of independent industrial waste treatment were not determined. Estimates of industrial waste quantities were not available, and no contact with officials of industrial activities was made during the study.

B. Determination of Needs

Determination of immediate action needs was based on whether or not pollution sources were interfering, or could be expected to interfere, with the water uses specified by the State[10,15] in waters which were expected to receive the specified uses to a significant degree. For the purpose of evaluating the significance of pollution sources, it was assumed that all large tidal waters received appreciable use of the types specified. On smaller tidal and non-tidal interstate waters, evaluations were made on each individual stream, primarily on the basis of size. In each case where there was interference with a water use, it was assumed that nuisance conditions existed or water quality was significantly degraded.

It should be noted that these criteria reflect the need to emphasize large tidal waters because of their importance as a multiple resource, and that they are not at variance with the States' water use classifications, which may apply to all waters regardless of size. This is particularly applicable in the case of Maryland water. Violations of quality standards have occurred in small creeks and ditches, primarily as a result of bacterial

contamination from overflowing septic tanks[37] . Unless such contamination was believed to extend downstream to interfere with significant water uses, it was considered a local public health problem only and not cited as a pollution control need. In cases where malfunctioning septic tanks were exerting an adverse effect on waters which received significant use, however, an entire sewerage system, as well as the treatment plant, was listed as a pollution control need.

Immediate needs have been interpreted here in a broad sense. Not only construction and special study needs but also organizational changes have been recommended because of the necessity of enhancing and protecting the water quality of the tidal waters in the face of accelerated population growth. The present importance of the tidewater resource, when evaluated in terms of dollar value, is not nearly as high as the potential overall benefits to regional economic development which may be attributable directly or indirectly to the resource.

It is important, therefore, that an institutional framework be established which can implement a comprehensive program of pollution control, embracing all of the water resources in the area.

III. SUMMARY AND CONCLUSIONS

A. Findings

Pollution control needs on the Eastern Shore reflect the fragmented drainage system, the scattered rural population, the predominance of the food processing industry, and the fact that almost all waters are classified as recreational or shellfish waters. Because many of the problems are relatively small and remote, the distinction between public health and water quality needs is often arbitrary. Most of the pollution control needs can be met by proper application of existing technology, but because of the lack of adequate records and inventories of pollution sources and quantities, further studies are needed to determine the effect of rural pollution sources such as poultry farms and the extent of pollution control measures beyond conventional secondary treatment needed at some of the larger waste sources.

While the trends outlined in Part IV tend to reduce the total waste from the food processing industry, the industry remains the largest single waste producer on the Eastern Shore, and in many instances has not provided adequate treatment of its wastes or else has not assumed its share of waste treatment costs. In Maryland, food processing wastes have frequently been treated by towns without charge as an incentive to industry because the food processing industry is an important employer--particularly of unskilled labor, of which there is a surplus in the area.

Frequently (though occasionally only seasonally) the food processing wastes overload or otherwise interfere with the operation of municipally-owned sewage treatment plants[25,35,36].

The only other industry in the area which discharges significant waste loads is the chemical industry which has contributed to pollution problems in the Elk River. Municipal discharges adversely affect water quality throughout the Eastern Shore. The principal immediate pollution control needs in the area are related to municipal or food industry discharges, or to a combination of both.

Although the principal pollution problems are associated with larger discharges, seepage from small towns, rural communities, and dwelling units along the shoreline can have a cumulative effect on water use far out of proportion to the size of the discharges.

The problem of waste treatment for small towns and communities needs attention for two reasons: first, small communities do not have the resources to adequately plan, construct and operate treatment facilities; and secondly, construction of conventional sewers and waste treatment facilities for small communities involves high per capita costs which vary widely among towns in different locations. Establishment of governmental units, with resources sufficient to cope with these problems has been recommended in Section III-B. Studies of ways to reduce overall costs have also been recommended.

Shellfish harvesting requirements[12,36,41] considerably influence pollution control needs for the Shore. Waters may be

closed to shellfishing on the basis of: (a) demonstrated bacterial contamination*; (b) lack of evidence that no pollution sources exist in the area (a survey within the last ten years should have indicated that the shoreline is free of waste flows or seepages); (c) possible contamination from sewage plant discharges. A buffer zone is required surrounding each sewage treatment plant outfall and is determined by the time required to notify authorities and to close the waters in case of malfunction. The buffer zone is generally the area over which a tracer dye will diffuse in 24 hours.

Eliminating pollution from defective septic tank systems by replacing them with sewers and treatment facilities may conceivably establish a buffer zone larger than the original polluted area unless adequate plant control and alarm systems are provided, or unless treated wastes can be discharged to areas whose principal value is as seed oyster beds and whose harvest for direct consumption is of negligible value.

The positions of the States of Maryland and Virginia represent opposite schools of thought on shellfish water policy. Maryland has classified all Eastern Shore waters where shellfish grow as shellfish-harvesting waters[10] and has indicated an intention to open prohibited waters. Virginia has exempted from the shellfish

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* Median coliform density not to exceed 70 MPN per 100 ml and no more than 10 per cent of the samples to exceed 330 MPN per 100 ml.

harvesting classification those waters now "condemned" by "people activity"* and has stated that most of these areas probably cannot be recovered[15]. A study of benefits to the Eastern Shore economy which can be realized by selective protection of shellfish waters is recommended in Section III-B.

Water quality of the rivers of the Eastern Shore may be further endangered by rapid eutrophication caused by nutrient rich discharges from developing urban areas and agricultural activities. Some Eastern Shore rivers are naturally eutrophic, but there is a possibility that eutrophication is accelerating[44].

B. Summary of Immediate Needs

1. Waste Treatment

Raw or partially treated wastes from ten small towns and thirteen industries, wastes from the two largest metropolitan areas, and eight aggregations of unsatisfactory septic tank systems interfere with proposed water uses. The provision of adequate waste treatment facilities to correct these situations is the Eastern Shore's most important immediate pollution control need.

Table I presents a tabulation of pollution sources, corrective action required and estimated costs for needed facilities. The program as outlined will require continuous updating and modifications as more complete and reliable data become available on

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* Terms used by VSDH

waste loads, diffusion characteristics, assimilative characteristics, and the present state of eutrophication of the rivers in the area.

Conventional secondary treatment with 85 per cent removal of the BOD and chlorination of treated effluents have been generally recommended for polluting discharges. Measures required beyond conventional waste treatment, such as flow diversion and advanced waste treatment, were not determined for this study because of the lack of data.

Further investigations, recommended in the next Section, will probably reveal a need for additional pollution control action in certain areas, especially for the food and poultry associated industries throughout the Eastern Shore and for the chemical industries in Cecil County, Maryland. For this reason, the recommended equivalent of secondary treatment is a necessary minimum level of treatment but should not be considered adequate unless it can be demonstrated that acceptable water quality levels can be maintained.

2. Special Studies

Special studies to determine requirements for measures in addition to the construction needs cited and to determine more economical solutions to existing problems are listed in Table II.

The objective of future studies should be to determine optimum methods of protecting and enhancing the water quality in the area in accordance with accepted State stream standards. Alternative methods of achieving the desired results should be investigated with emphasis on the development of a unified area-wide pollution control program.

TABLE I

IMMEDIATE CONSTRUCTION NEEDS

Town, Area or Industry	Population	Water Affected	Existing Facility	Action Needed	*Estimated Cost	
1. Atlantic Coast Drainage, Maryland (Delaware border to Virginia border)						
Ocean City, Md. (Worcester)	1,800 winter 150,000 summer peak	Ocean City Inlet Sinepuxent Bay Isle of Wight Bay	Sewers in town proper, no treatment	Secondary Ocean outfall	Cons.	$3,600,000
					Cons.	600,000
					Other	840,000
					Project	$5,000,000
					**Annual	$ 340,000
Selbyville, Del. (Sussex)	1,000	Sandy Branch Buntings Branch Bishopville Prong	Septic tanks overflow and raw sewage discharges	Sewers Secondary	Cons.	$ 480,000
					Cons.	240,000
					Other	140,000
					Project	$ 860,000
					Capital	$ 66,000
					O & M	9,000
					**Annual	$ 77,000
H and H Poultry Co. (Selbyville, Del.)	---	do	Settling, Chlorination	Equivalent of secondary	Undetermined	
Bishop Processing Co. Bishop, Md. (Worcester)	---	do	None	Equivalent of secondary	Undetermined	
Berlin, Md. (Worcester)	2,100	Kitts Creek Trappe Creek Newport Bay	Imhoff tank (1935 - design 1600 population)	Secondary	Cons.	$ 420,000
					Other	94,000
					Project	$ 514,000
					Capital	$ 40,000
					O & M	13,000
					**Annual	$ 53,000

TABLE I (Continued)

IMMEDIATE CONSTRUCTION NEEDS

Town, Area or Industry	Population	Water Affected	Existing Facility	Action Needed	*Estimated Cost
Ralph H. Mason Canning Co., Newark, Md. (Worcester)	---	Marshall Creek Chincoteague Bay	Screening	Equivalent of secondary	Undetermined
2. Atlantic and Chesapeake Bay Drainage, Virginia Peninsula					
Chincoteague, Va. (Accomack)	2,800 (town) 4,000 (island)	Chincoteague Channel	Septic tanks	Sewers ***Secondary	Cons. $ 940,000 Cons. 340,000 Other 320,000 Project $1,600,000 Capital $ 120,000 O & M 12,000 **Annual $ 132,000
Onancock, Va. (Accomack)	1,800	Onancock Creek	Unknown, believed inadequate	Secondary	Undetermined
Cape Charles, Va. (Northampton)	2,100	Cape Charles Harbor, Chesapeake Bay	Sewers, no treatment	Secondary	Cons. $ 320,000 Other 60,000 Project $ 380,000 Capital $ 29,000 O & M 14,000 **Annual $ 43,000

TABLE I (Continued)

IMMEDIATE CONSTRUCTION NEEDS

Town, Area or Industry	Population	Water Affected	Existing Facility	Action Needed	*Estimated Cost
3. Northeastern Chesapeake Bay Drainage, Susquehanna River, Stump Point to Chester River, Swan Point, Maryland					
Northeast River Basin					
North East, Md. (Cecil)	1,600 3,000 est. des. population	Pedlars Run Northeast River	Primary, post-Cl_2	Add secondary	Cons. $ 110,000 Other 22,000 Project $ 132,000 Capital $ 10,000 O & M 5,000 **Annual $ 15,000
Elk River Basin					
Airco Chemical Div. of Cumberland Chem. Corp., Elkton, Md. (Cecil)	---	Bens Gut Big Elk Creek	Polyvinyl acetate Inadequate	Equivalent of secondary or combine with Elkton STP	Undetermined
Galaxy Chemicals, Inc., Providence, Md. (Cecil)	---	Little Elk Creek	None - strong waste c/o butanol and organic solids	Equivalent of secondary	Undetermined
Chemetron Chemicals Elkton, Md. (Cecil)	---	Little Elk Creek	Neutralization of acid and caustic wastes, unreliable	Adequate control of neutralization	Undetermined
Stauffer Chemical Co. (Elkton, Md.)	---	Little Elk Creek	Unknown - acid wastes observed	Neutralization	Undetermined

TABLE I (Continued)

IMMEDIATE CONSTRUCTION NEEDS

Town, Area or Industry	Population	Water Affected	Existing Facility	Action Needed	*Estimated Cost	
Elk River Basin (continued)						
Chesapeake City, Md. (Cecil)	1,100 (1960)	Chesapeake and Delaware Canal, Back Creek	Imhoff tanks (1939)	Secondary	Cons.	$ 260,000
					Other	52,000
					Project	$ 312,000
					Capital	$ 24,000
					O & M	12,000
					**Annual	$ 36,000
Losten Dairy Chesapeake City, Md.	---	Chesapeake and Delaware Canal	Inadequate	Equivalent secondary	Undetermined	
4. **Chester River Basin**						
Queenstown, Md. (Queen Annes)	375; 600 design	Queenstown Creek	Septic tanks	Sewers	Cons.	$ 290,000
					Cons.	72,000
					Other	103,000
					Project	$ 465,000
					Capital	$ 36,000
					O & M	2,000
					**Annual	$ 38,000
Rock Hall, Md. (Kent)	(Resort) 1,200 avg., 1,500 design	Rock Hall Harbor	Septic tanks	Sewers Lagoon	Cons.	$ 350,000
					Cons.	26,000
					Project	$ 376,000
					Capital	$ 29,000
					O & M	6,000
					**Annual	$ 35,000

TABLE I (Continued)

IMMEDIATE CONSTRUCTION NEEDS

Town, Area or Industry	Population	Water Affected	Existing Facility	Action Needed	*Estimated Cost
5. Eastern Bay Drainage					
Rural Shoreline area and communities (Talbot and Queen Annes, Md.)	Unknown	Tributaries to Miles Run: Spencer Creek, Little Neck Creek, Newcomb Creek, Leeds Creek and Wye River, Wye East River, Wye Narrows, Skipton Creek	Septic tanks	Correct shoreline violations	Undetermined
6. Choptank River Basin					
Greensboro, Md. (Caroline)	1,200 (1964)	Choptank River	Sewers, no treatment	Secondary	Cons. $ 290,000 Other 58,000 Project $ 348,000 Capital $ 27,000 O & M 14,000 **Annual $ 41,000
Textron Co. Denton, Md. (Caroline)	---	Choptank River	Screening - poultry processing wastes	Equivalent of secondary	Undetermined
Ridgeley, Md. (Caroline)	900 (1964)	Tuckahoe Creek Choptank River	Primary minus (1914)	Secondary	Cons. $ 220,000 Other 44,000 Project $ 264,000 Capital $ 20,000 O & M 10,000 **Annual $ 30,000

TABLE I (Continued)

IMMEDIATE CONSTRUCTION NEEDS

Town, Area or Industry	Population	Water Affected	Existing Facility	Action Needed	*Estimated Cost	
Choptank River Basin (continued)						
East New Market, Md. (Dorchester)	225 (1960)	Warwick River Choptank River	Imhoff tank, Cl_2 (1939)	Secondary	Cons.	$ 60,000
					Other	12,000
					Project	$ 72,000
					Capital	$ 5,500
					O & M	2,800
					**Annual	$ 8,300
Secretary, Md. (Dorchester)	365; 600 design	Warwick River Choptank River	Septic tanks	Sewers Lagoon	Cons.	$ 190,000
					Cons.	183,000
					Other	99,000
					Project	$ 472,000
					Capital	$ 36,000
					O & M	2,000
					**Annual	$ 38,000
Rural shoreline area and remaining communities upstream from Cambridge	Unknown	Choptank River and tributaries	Septic tanks	Correct violations revealed by surveys	Undetermined	
Cambridge, Md. including large industrial organic and grease load	13,000, 52,000 PE	Choptank River	Primary, heavy pre and post Cl_2	Add secondary and digesters	Cons.	$1,600,000
					Other	400,000
					Project	$2,000,000
					Capital	$ 154,000
					O & M	31,000
					**Annual	$ 185,000

TABLE I (Continued)

IMMEDIATE CONSTRUCTION NEEDS

Town, Area or Industry	Population	Water Affected	Existing Facility	Action Needed	*Estimated Cost	
7. Nanticoke River Basin						
Seaford, Del. (Sussex)	4,400	Nanticoke River	Primary, post Cl_2	Add secondary	Undetermined	
Sharptown, Md. (Wicomico)	700	Nanticoke River	Sewers, no treatment	Secondary	Cons.	$ 170,000
					Other	34,000
					Project	$ 204,000
					Capital	$ 16,000
					O & M	8,000
					**Annual	$ 24,000
Federalsburg, Md. (Caroline)	2,100 (1960)	Marshy Hope Creek	Trickling filter adequate except for seasonal overload from sweet potato wastes	Industrial pre-treatment or STP expansion	Undetermined	
Vienna, Md. (Dorchester)	400; 600 design	Nanticoke River	Mostly sewered, no treatment	Lagoon, Lift station, Force main and Outfall	Cons.	$ 97,000
					Other	18,000
					Project	$ 115,000
					Capital	$ 8,800
					O & M	6,300
					**Annual	$ 15,100

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TABLE I (Continued)

IMMEDIATE CONSTRUCTION NEEDS

Town, Area or Industry	Population	Water Affected	Existing Facility	Action Needed	*Estimated Cost	
8. Wicomico River Basin						
***Salisbury, Md. (Wicomico) including large industrial waste load	28,000 served 84,000 PE (1966); 60,000 240,000 PE (1985 design)	Wicomico River	Secondary post Cl_2 (overloaded)	STP expansion to handle industrial loads	Cons. Other Project	$1,210,000 440,000 $1,650,000
					Capital O & M **Annual	$ 127,000 79,000 $ 206,000
***Fruitland, Md. (Wicomico)	2,400; 3,700 design	Wicomico River and small tributaries and ditches	Septic tanks	Sewers Secondary	Cons. Cons. Cons. Other Project	$ 914,000 310,000 122,000 372,000 $1,718,000
					Capital O & M **Annual	$ 132,000 22,000 $ 154,000
***Green Giant Corp. Delaney Frozen Foods Div., Fruitland, Md. (Wicomico)	---	Sharps Branch Wicomico River	Land disposal; pollution from seepage and runoff, especially sweet potato processing	Equivalent of secondary	Undetermined	
9. Little Annemessex River						
Crisfield, Md. (Somerset)	3,500	Little Annemessex River	Primary, chlorination	Add secondary	Undetermined	

TABLE I (Continued)

IMMEDIATE CONSTRUCTION NEEDS

Town, Area or Industry	Population	Water Affected	Existing Facility	Action Needed	*Estimated Cost
10. Pocomoke River Basin and Pocomoke Sound					
Snow Hill, Md. (Worcester)	2,400	Pocomoke River	Primary, Post Cl_2	Secondary	Undetermined
Maryland Chicken Processors, Inc. Snow Hill, Md. (Worcester)	11,000 PE	Pocomoke River	Screening	Equivalent of secondary	Cons. $ 150,000 Other 9,000 Project $ 159,000 Capital $ 12,000 O & M 11,000 **Annual $ 23,000
W. T. Onley Co. Snow Hill, Md. (Worcester)	---	Pocomoke River	Screening (vegetable canning)	Secondary	Undetermined
Pocomoke City, Md. (Worcester)	3,400	Pocomoke River	Sewers, no treatment	Interceptor and Lagoon	Project $2,400,000 **Annual $ 185,000
Campbell Soup Co.	---	do	Not yet in production	To planned Pocomoke City Lagoon	---
Pocomoke Provision Co.	---	do	None	do	---
Johnson Meat Products Co.	---	do	do	do	---
Mason Canning Co., Inc.	---	do	do	do	---
G. S. Bull Co. (slaughtering)	---	do	do	do	---

TABLE I (Continued)

IMMEDIATE CONSTRUCTION NEEDS

Town, Area or Industry	Population	Water Affected	Existing Facility	Action Needed	*Estimated Cost
Pocomoke River Basin and Pocomoke Sound (continued)					
H. E. Kelley & Co. (canning) New Church, Va. (Accomack)	---	Unnamed tributary, maybe Pitts Creek	Unknown, less than secondary	Equivalent of secondary	Undetermined
			Total Project Costs		$19,041,000
	TOTAL COSTS		Total Annual Cost of Capital Investment		$ 1,161,000

* "Cons." - Construction cost
"Other" - Land, administration, engineering contingency, and other associated costs
"Project" - Total investment cost of project = sum of construction and other costs
"Capital" - Annual cost of project investment capital, computed at 4.5 per cent over 20 year period

** Annual cost of project investment only

*** Additional study needed before construction; see Area Needs

TABLE II

SPECIAL STUDY NEEDS

Description of Study	Where Required	Agency Responsible
1. Shoreline Pollution Sources: Determine existence of present or potential interference with proposed water uses from unsewered shoreline towns, communities and fringe areas served by septic tanks, marinas, boats and rural sources on the basis of existing data or from field studies as necessary. If a problem exists, determine feasible methods of correction.	a. Northeast Chesapeake Bay Area (Northeast River, Elk River, Sassafras River and tributaries, and direct Chesapeake Bay drainage to Swan Point).	MSDH, MDWR, Cecil County Health Dept., Kent County Health Dept.
	b. Kent Island-Kent Narrows area, from Kent Island to Wye River, including Queenstown, Md.	MSDH, MDWR, Queen Annes County Health Dept.
	c. Wicomico River above Wicomico Creek, and Wicomico Creek	MSDH, MDWR, Wicomico County Health Dept.
	d. Little Annemessex River (Crisfield, Md., fringe area)	MSDH, MDWR, Somerset County Health Dept.
2. Shellfish Waters: Estimate net primary, secondary and intangible benefits to the Eastern Shore economy to be realized by protecting shellfish waters. Consider providing adequate reliability for waste treatment plants, relocating discharge points, and other methods as may be found feasible to protect shellfish harvesting. Indicate waters which will suffer minimal loss in value from prohibition of harvesting for direct consumption.	Shellfish waters below present and future outfalls, and those waters where harvesting is now prohibited because of land runoff or shoreline septic tank malfunctions.	MSDH, MDCBA, VSDH

TABLE II (Continued)

SPECIAL STUDY NEEDS

Description of Study	Where Required	Agency Responsible
3. Rural Disposal Methods: Study alternative to conventional sewerage and sewage treatment for small communities. Determine feasibility in terms of cost, ease of operation and maintenance, and reliability. This could include small house-group treatment by package plant, additional treatment and chlorination of septic tank effluent, etc.	Not Applicable.	FWPCA, MSDH, VSDH (by contract or R & D branch)
4. Consolidated Waste Treatment Facilities: Determine treatment needs and optimal combinations of treatment facilities, considering immediate and long-term effects on water quality.	a. Wicomico River (Salisbury and Fruitland, Md., and industries).	FWPCA, MDWR, MSDH
	b. Other areas as indicated by further investigation.	FWPCA, State agencies
5. Eutrophication of Rivers: Determine the present state of eutrophication and the degree to which it is being accelerated by increased metropolitan growth and agricultural activity.	All Rivers	DWARC, MDWR, VWCB, FWPCA
6. Other Field Studies	As indicated by further study based upon data compilations.	DWARC, MDWR, VWCB, FWPCA

3. Institutional Practices

A need for certain organizational changes and institutional practices is indicated by the findings of this study. Action should be taken by the States to promote the establishment of interjurisdictional area sewerage organizations for the following purposes:

a. Contracting for construction of pollution control works.

b. Maintaining consolidated operating staffs for treatment plants in the area.

c. Adopting and enforcing sewer ordinances and charging for waste treatment services if charges are found to be appropriate and desirable.

d. Distributing costs in a manner determined to be fair.

IV. BASIN DESCRIPTION

A. Area and Population

The Maryland and Virginia Atlantic drainage and the Chesapeake Bay drainage of the Eastern Shore include all of Virginia's two Eastern Shore counties, western and southern Delaware (parts of all three counties comprising slightly more than one-third of the State) and all of Maryland's Eastern Shore except for about one-fourth of Cecil County which drains to the Susquehanna and Delaware Rivers. A small part of Chester County in southeastern Pennsylvania also lies within the Basin, and the entire Chesapeake and Delaware Canal, an important commercial waterway between Chesapeake Bay and Delaware River (Cecil County, Maryland, and New Castle County, Delaware) was included arbitrarily. The entire Eastern Shore except northern Cecil County and the Pennsylvania portion lies in the Coastal Plain geophysical province. The Fall Line runs roughly northeastward across Cecil County from the mouth of the Susquehanna River, and divides the County approximately in half. Traditionally and economically, the area north of the Chesapeake and Delaware Canal is not a part of the Eastern Shore, but it is necessarily included for the basin-oriented study.

Land areas and population are presented in the following table.

TABLE III

LAND AREA AND POPULATION, EASTERN SHORE
CHESAPEAKE BAY AND MARYLAND AND VIRGINIA
ATLANTIC OCEAN DRAINAGE[3]

	Area (square mile)	Population (1965)
Delaware	460	44,800
Maryland	3,290	215,500
Pennsylvania	90	700
Virginia	700	47,400
TOTAL	4,590	308,400

Only eight towns in the basin have populations of 2,500 or more.

TABLE IV

TOWNS OF POPULATION GREATER THAN 2,500[5]

Town	County	Population (1965)
Salisbury (Salisbury Metropolitan Area)	Wicomico, Md.	16,300 (36,000)
Cambridge	Dorchester, Md.	12,200
Easton	Talbot, Md.	6,300
Seaford	Sussex, Del.	4,400
Chestertown	Kent, Md.	3,650
Crisfield	Somerset, Md.	3,500
Pocomoke City	Worcester, Md.	3,350
Laurel	Sussex, Del.	2,750

Except for the Salisbury metropolitan area, these numbers do not include fringe areas or adjacent town populations, some of which are significant. Both the Salisbury and Cambridge areas are growing rapidly, and there is also growth in other towns and rural areas as well. Increasing activity along the shoreline is reported in Virginia[41].

Census tabulations for all towns, unincorporated communities of 1,000 or more, and farm populations, plus a road map[13] count of unincorporated communities of less than 1,000 accounted for only 70 per cent of the total population. The place of residence of the other 30 per cent of the Eastern Shore population could not be determined from the information available; and in Cecil County, Maryland, 59 per cent were found to live in places not on the road map and also not on farms. Many of these residents undoubtedly live in small shoreline communities and subdivisions, as well as in fringe areas of the larger towns and in hamlets along highways. In the northeastern Chesapeake Bay region (Cecil and Kent Counties, Maryland) and at the eastern end of Bay Bridge (the Kent Island-Kent Narrows are in Queen Annes County, Maryland) shoreline communities are expanding rapidly.

B. Water Use and Hydrology

Tidewaters are the most important water resources of the Eastern Shore. The free-flowing river reaches are short compared to the tidal portions, and much of the runoff goes directly into

tidewater through small sandy runs of which there is little water [illegible]. Except for the major estuaries, there is no central river system of any importance (Figure 1).

Surface water is unimportant as a source of municipal or industrial water supply. Of nine withdrawals, only three are in the coastal plain province. The majority of agricultural water use, however, is surface water from fresh water streams and from normally brackish waters when salinities are low.

Average annual rainfall over Maryland's Eastern Shore is about 43 inches, more than half of which is removed by evaporation and transpiration. Local average rainfalls, however, vary significantly. The average stream flow is 1.14 cfs per square mile, equivalent to 36 per cent of the mean annual precipitation[11].

In many locations high tide rises to a point halfway across the peninsula. On the Pocomoke River, the head of tide is above Snow Hill, Maryland; on Nanticoke River it reaches Seaford, Delaware. Except in northwestern Cecil County, ground elevations rarely exceed fifty feet. The divide between Chesapeake Bay and Delaware Bay drainage parallels the Delaware coast about ten miles inland, so that most of the Eastern Shore is in the Chesapeake Bay Basin. Rivers on the southern half of the Shore flow much of their length through marsh; the Pocomoke in particular originates and flows virtually its entire length through cypress swamp. Large volumes of water are available far inland, and low stream flow conditions affect waste dilution principally by reducing the net

seaward movement. Under low flow conditions there is also considerable salt-water encroachment into the Wicomico, Nanticoke, Choptank and Chester Rivers[11]. Because of the flat terrain, generally sandy soil and lack of concentrated runoff, flow augmentation is not a pollution control alternative on the Eastern Shore.

C. Economy

Agriculture and related activities are the outstanding industries on the Eastern Shore. In 1964, the total value of farm products sold on the Delmarva peninsula, the majority of which is in the study area, was $264 million (55 per cent from poultry alone). By comparison, the value of shellfish sold in 1964 was $8.4 million, and the value of the entire fishery catch was $14.5 million. Fifteen per cent of the Eastern Shore work force was engaged in agriculture and ten per cent in food manufacturing (including seafood) in 1964[5].

Certain trends in the agricultural industry are significant in terms of water quality. There is a trend toward consolidation of poultry processing plants. Although poultry raising is increasing, the number of processing plants in Delaware declined from 15 to six in the last 15 years. Two of the six existing plants, however, are integrated egg to product operations, including by-product rendering, and the other four are moving in this direction[33]. Concurrently, with the increase in poultry raising is an increased emphasis on easily harvested field crops for feed at the expense of vegetables[5]. The number of small canneries is declining, probably as a result of the decreased proportion of vegetables and competition from larger, more efficient plants.

Clamming and oystering, both of which depend on high water quality, are traditional occupations on the Eastern Shore. Oysters accounted for 43 per cent and soft-shelled clams for 16 per cent of the value of the total fishery catch in 1964. The value of the shellfish harvest declined 18 per cent during the period 1960-64; a 25 per cent decline in the value of the oyster harvest was slightly offset by a five per cent increase in clams. Both species, moreover, lost ground in relation to the national shellfish production[33]. Management practices in Maryland were responsible for a serious depletion of oysters in former years[5]. There are present indications that the oyster industry is making a comeback.

The MSX oyster virus appeared in Atlantic waters and in Chesapeake Bay as far north as Tangier Sound in 1959-60. The disease produced by this virus, which affects young oysters, cut deeply into shellfish production in these waters. The Virginia harvest has partially recovered through harvesting waters of salinity too low to support the virus. These headwaters, however, are more subject to pollution and produce oysters of lower quality[41].

While care should be taken to avoid over-reliance on shellfish as a factor in economic development[5], the industry is still important, accounting for a large share of the ten per cent of the labor force employed by the seafood industry in 1964, and it has a significant growth potential, given adequate resource management, pollution control, and some promotional effort.

V. RECENT PROGRESS IN POLLUTION CONTROL

The most significant progress has been the increased attention now being paid to Eastern Shore problems and to pollution control in general. Several new sewage treatment plants have been built within the last few years, and many more are in the planning stage. Field surveys and surveillance activities being conducted by States and the FWPCA Chesapeake Field Station survey, will provide a much better picture of water quality than has been available in the past.

Planning activities have also taken place. Maryland has required each county to prepare comprehensive plans for water and sewerage by 1970[9]. It would be desirable for these planning activities to be conducted as a continuous process with adoption of interim plans for immediate needs before 1970, preparation of a comprehensive plan by the scheduled date, and periodic reviews and additional plans as required thereafter. The overall Economic Development Program of the Delmarva Advisory Council[5] which recognizes water pollution control as an essential need for the Eastern Shore is part of such a continuous activity. The life of the program as adopted is about a year, after which review and re-evaluation are necessary.

The Delaware State Planning Office and the Delaware Water and Air Resources Commission are cooperating with Sussex County officials and other Federal agencies in studies and the preparation of comprehensive development and comprehensive water and sewer plans

VI. IMMEDIATE POLLUTION CONTROL NEEDS

A. General Needs

The needs cited below are studies or actions generally applicable to the entire Basin.

1. Waste Source Inventory and Data Compilation

Recent progress in pollution control has done much to resolve principal pollution problems, and it is believed that all major existing sources of pollution are evaluated in this study. A program to maintain and improve water quality, however, will require a complete inventory of pollution sources which, for the Eastern Shore, will require the locating of rural pollution sources. Such detail is usually of minor significance in areas with less sensitive water uses, but it is essential for the Eastern Shore, in view of the large shellfish areas affected. The inventory should also include waste load discharges to streams and treatment plant efficiencies which will require a more comprehensive effluent sampling program than currently exists.

Water quality data in each State are recorded by the agency responsible for water quality (MDWR, VWCB, DWARC). Many bacteriological data, however, are also available from shellfish units in the State health departments and from local health departments. It is recommended that recent data be compiled and maintained in a central file in each State.

Establishment and maintenance of current waste inventory and water quality data files are an essential requirement for adequate pollution control and are the responsibility of the several State water quality control agencies (DWARC, MDWR, and VWCB) and of the FWPCA.

2. Field Studies

Current studies by the Chesapeake Field Station, FWPCA, and the State agencies, particularly MDWR, were designed to determine the extent and degree of known pollution. Attention was concentrated on major rivers, and the smaller streams were surveyed only where there was obvious gross pollution. Further intensive studies of organic and bacterial pollution are required to the extent indicated by further inspection of the area and gaps in existing data. There are undoubtedly many needs for surveys in minor streams.

Studies are needed to determine the present state of eutrophication and the degree to which it is being accelerated by man's activities. Eutrophic conditions exist in some Eastern Shore rivers, and have historically been of benefit to some water uses, but the growth of metropolitan areas and the increased importance of agriculture and application of modern techniques are a threat to previous natural balances. Field studies needed to make this determination are the responsibility of the State water quality control agencies (DWARC, MDWR, VWCB) and of the FWPCA.

3. Sewer Districts

The small size of most Eastern Shore communities and the marginal, highly competitive nature of the food processing industry offer obstacles to needed construction and reliable treatment plant operation. Existing administrative units, whether governmental or industrial, generally do not have the resources necessary to review plans or propose alternatives. Most towns are too small to afford many skilled employees, and sewage treatment plants have in the past received low priorities in municipal budgeting. Small towns and communities are also too small to obtain favorable interest rates in their bond financing.

It is recommended that formation of sewer districts to contract for necessary design and construction and to operate, maintain and administer the sewage treatment facilities after construction be promoted. Sewer districts independent of municipal governments also offer a promising means of apportioning combined industrial waste and municipal waste treatment costs by adopting regulatory sewer ordinances and a system of equitable charges for waste treatment. A sewer district organization will also be able to offer technical assistance to the planning agency because of the familiarity of district officials with local conditions.

Community waste disposal facilities are generally planned with primary emphasis upon economy rather than maintenance of receiving water quality. The sewer district offers the advantages of consolidating sewerage facilities to achieve the economy possible

through lower unit construction costs of the sewerage and sewage treatment plants, the more competent maintenance and operating personnel that can be provided and the incidental benefits of better receiving water quality that can be realized. Of the advantages cited above, the one which could be realized most quickly would be the greater competence available for small plant operation and more efficient and flexible use of operating staffs. Most of the small, separate treatment plants do not require a full-time operator, but it would be desirable to have an operating staff for a group of plants to provide for sickness, leave, personnel turnover and similar contingencies.

The DWARC presently encourages establishment of local sewer districts. The proposed Maryland Waste Acceptance Service is a step toward making water quality a primary instead of an incidental goal.

B. Area Needs

The following sections are detailed discussions of needs in areas where pollution is adversely affecting water use. Area needs are discussed in the following order:

1. Atlantic Coast Drainage of Maryland
   - Ocean City Inlet and Adjacent Waters
   - Buntings Branch and St. Martins River
   - Kitts Creek, Trappe Creek, and Newport Bay
   - Marshall Creek
2. Atlantic and Chesapeake Bay Drainage of the Virginia Peninsula
3. Northeastern Chesapeake Bay Area
   - Northeast River
   - Elk River

4. Chester River Basin
5. Eastern Bay Drainage
6. Choptank River Basin
7. Nanticoke River Basin
8. Wicomico River Basin
9. Little Annemessex River
10. Pocomoke River Basin

1. Atlantic Coast Drainage of Maryland

Maryland's Atlantic Coast Drainage area consists of a strip of land extending two to ten miles inland, including a small area of lower Sussex County, Delaware. This strip drains into a series of landlocked bays enclosed by Fenwick and Assateague Islands, and thence to the Atlantic Ocean. Major coastal waters are Assawoman Bay, Isle of Wight Bay, Sinepuxent Bay, Newport Bay and Chincoteague Bay. Drainage to the Atlantic occurs through Ocean City Inlet and several channels at the southern end of Chincoteague Bay. These are still important shellfish waters, although the oyster harvest has been affected by the MSX virus; Chincoteague oysters, particularly, are well-known for their flavor and quality and highly valued as raw-bar stock.

Ocean City Inlet and Adjacent Waters

Ocean City, Maryland, at the southern end of Fenwick Island, discharges sewage to Ocean City Inlet without treatment. This has required closing adjacent landward bay waters to shellfish

harvesting [4]. The discharge may also affect the bacterial quality of ocean beach waters. Ocean City has an extremely variable population; the permanent population of 1,800 may increase to as much as 150,000 on a summer weekend, although not all of the visitors occupy areas served by sewers. To cope with this problem, consulting engineers have recommended dual treatment plants -- a small plant for permanent residents and a large plant for summer operation. Both plants are to be of only primary treatment capability, but a 4,000-foot outfall will carry the effluent to the Atlantic Ocean[37]. There is some doubt as to whether or not this combination is adequate in view of the intensive use of the ocean beaches and the possibility that the plant effluent could be driven back onto the beach. Secondary treatment for 100,000 population during the summer season has, therefore, been specified as an immediate need. Ocean City should be required to show that it would be impossible for the sewage effluent to return to the ocean beaches except under the most unusual storm conditions before a primary plant is considered acceptable. Adequate plant control measures are also essential.

Buntings Branch and St. Martins River

Buntings Branch and its tributary, Sandy Branch, are polluted by septic tank overflows and direct sewage discharges from the unsewered town of Selbyville, Delaware. The H and H Poultry Company, a fairly small operation located in Selbyville, discharges wastes after some settling and chlorination [33]. These wastes cause serious degradation of Buntings Branch water quality[43].

Just south of the Delaware border, Buntings Branch receives waste from the Bishop Processing Company near Bishop, Maryland, via a small tributary. The effluent from the processing (rendering) plant is a foul, bluish-black stream carrying large floating solids and globs of grease[43]. Flows estimated by MDWR as a part of its Buntings Branch water quality survey were all greater than one million gallons per day[14]. It was not ascertained whether the waste stream came from the plant directly or from a break in the wall of a lagoon, which at the time of observation was a festering swamp. Any attempt being made by the processing company to treat its waste was grossly inadequate.

At Bishopville, Maryland, a small impoundment on Buntings Branch, originally intended as a recreational pond, is grossly polluted by the three sources cited above. The water was sooty black and putrid at the time of inspection. Water quality in Bishopville Prong of St. Martin's River is also adversely affected by these wastes[43]. The two industries cited above should provide waste treatment adequate to maintain water quality standards as soon as possible. Selbyville, Delaware, should construct sewers and provide secondary treatment for its sewage. Consideration should be given to combined treatment of Selbyville and H and H Poultry Company wastes, to the extent that it is consistent with policies of the DWARC. Both Selbyville and the H and H Poultry Company are under orders from DWARC to abate the pollution caused by their discharges.

Kitts Creek, Trappe Creek, Newport Bay

These waters are adversely affected to an undetermined degree and extent by sewage and laundry wastes from Berlin, Maryland (population 2,100), which receives inadequate treatment in an overloaded, obsolete Imhoff tank constructed in 1935. Consulting engineers have recommended secondary treatment for these wastes[21], and this has been listed as an immediate need.

Marshall Creek

The Ralph L. Mason Canning Company seasonally discharges wastes from tomato canning operations with screening treatment only. This waste seriously degrades the water quality of Marshall Creek and creates an obvious nuisance [6]. The Mason Company should provide a minimum equivalent of secondary treatment.

2. Atlantic and Chesapeake Bay Drainage of the Virginia Peninsula

The Virginia Eastern Shore, consisting of Northampton and Accomack Counties, extends 65 miles southward from the Maryland border to Cape Charles, at the mouth of Chesapeake Bay. The peninsula is only ten miles wide at its broadest point, excluding the extensive coastal marshes on the Atlantic side. The Pocomoke River and Sound, portions of which are in Virginia, are discussed separately.

Chincoteague, Virginia (town population 2,800, island population 4,000), has a serious problem because of a concentration

of septic tanks in an area generally unsuitable for tile fields. Sewers and treatment facilities should be constructed. Shellfish harvesting is now the principal income on the island, but tourism is expected to increase rapidly because of the island's location at the southern end of the Assateague National Seashore. Plant control measures should be provided, or a discharge location selected, so that the treated discharge will not interfere with either shellfish or tourism.

Onancock, Virginia (population 1,800), discharges sewage to Onancock Creek after treatment which is believed to be inadequate. Secondary treatment has been recommended as an immediate need, unless further investigation reveals that present treatment is adequate.

The Town of Cape Charles, Virginia (population 2,100), discharges sewage without treatment to Cape Charles Harbor. Cape Charles sewage should receive secondary treatment.

There are several industries on the peninsula with significant pollution potential. The Green Giant Corporation operates a food manufacturing plant near Exmore, and there are menhaden processing plants at several locations. The VWCB has indicated that these plants cause no water quality problems in tidal waters[15,42]. Surveillance of water quality below these plants should be continued.

Waters are closed to shellfish harvesting at seven locations on the Virginia Eastern Shore, in addition to the

Pocomoke areas. Two of the closed areas are sewage treatment plant buffer zones, and one is the result of the Cape Charles sewage discharge. The remaining four are closed because of shoreline activity or land runoff from unsewered areas. Other areas are expected to be closed in the foreseeable future[41] and the VSDH has stated that the areas already closed probably cannot be recovered[15]. These areas should not be abandoned without fully exploring the possible means of recovering them. Sanitary conditions in many locations along the Virginia peninsula, particularly in migrant labor camps, are notoriously poor, and correcting such conditions at shoreline locations would probably produce significant improvement in the sanitary quality of adjacent waters.

The value of the shellfish which might be harvested from recovered areas, however, is probably not as important as the value of the recreational potential as an attraction both to tourists and to new residents. Action should be taken to insure that this potential is not diminished. Bacteriological data and shoreline conditions should be reviewed to determine where bacterial contamination might interfere with recreational uses.

3. Northeastern Chesapeake Bay Area, Stump Point (Susquehanna River) to Swan Point (Chester River), Maryland

Waters of this region, because of their proximity to Baltimore, Wilmington and Philadelphia, and because of their natural beauty, are among the most popular recreational waters of the Chesapeake Bay Area. Sassafras River, in particular, is

considered by many the most beautiful river of the Eastern Shore. Elk and Northeast Rivers are the other two large rivers which are tributary to the Bay, and the Chesapeake and Delaware Canal runs eastward from Elk River to the Delaware River. There are, in addition, many creeks in the area which drain directly to Chesapeake Bay. Most of the shoreline lies in Cecil County and the remainder in Kent County, Maryland. Headwaters of streams are in northern Delaware (New Castle County) and southeastern Pennsylvania (Chester County).

Along the shorelines of the rivers are numerous small communities. Some are composed predominantly of summer homes, but others have many year-round residences. It is estimated that in Cecil County as much as half of the population lives in small communities and rural subdivisions, many of which are located on the shoreline and almost all of which are served by septic tanks. Although sanitary conditions have not required that any bathing beaches be closed, coliform densities of 1,000 MPN per 100 ml and greater have been found on occasion by the Cecil County Department of Health [31]. Some of these densities may possibly be attributed to treated sewage discharges, and chlorination procedure at existing sewage treatment plants in this region should be reviewed.

Continued development of unsewered communities, including conversion of summer homes to year-round residences, however, poses an immediate threat to water quality. A detailed study should be made of the area, especially along the shoreline, to determine the

considered by many the most beautiful river of the Eastern Shore. Elk and Northeast Rivers are the other two large rivers which are tributary to the Bay, and the Chesapeake and Delaware Canal runs eastward from Elk River to the Delaware River. There are, in addition, many creeks in the area which drain directly to Chesapeake Bay. Most of the shoreline lies in Cecil County and the remainder in Kent County, Maryland. Headwaters of streams are in northern Delaware (New Castle County) and southeastern Pennsylvania (Chester County).

Along the shorelines of the rivers are numerous small communities. Some are composed predominantly of summer homes, but others have many year-round residences. It is estimated that in Cecil County as much as half of the population lives in small communities and rural subdivisions, many of which are located on the shoreline and almost all of which are served by septic tanks. Although sanitary conditions have not required that any bathing beaches be closed, coliform densities of 1,000 MPN per 100 ml and greater have been found on occasion by the Cecil County Department of Health [31]. Some of these densities may possibly be attributed to treated sewage discharges, and chlorination procedure at existing sewage treatment plants in this region should be reviewed.

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existence of a water quality problem. If a problem exists, the extent to which further development of the shoreline can be expected and the feasible means of providing treatment facilities should be explored.

The northernmost shellfish beds in Chesapeake Bay lie in the northeast region, between Pooles Island and Swan Point. This area is closed to shellfish harvesting from March 15 to May 1 because of excessive coliform counts from the Susquehanna River during spring runoff release from flood gates [4]. This water may also contribute to high coliform densities experienced in the rivers to the north.

Conditions other than bacterial quality in the rivers adjoining Chesapeake Bay in the northeast region are as follows:

Northeast River

The Town of North East, Maryland (population 1,630), discharges sewage to Pedlars Run, near the head of tide in the Northeast River, after primary treatment and chlorination. This plant should provide secondary treatment, although at the present time it is believed that there is only marginal interference with water use.

Elk River

Elk River tributaries are of good quality where they enter Maryland from Pennsylvania, but industrial discharges cause serious degradation of Little Elk Creek between the Pennsylvania border and the head of Elk River. Galaxy Chemicals, Incorporated, in Providence, Maryland, discharges a strong butanol and organic solvent waste in

unknown quantities. Chemetron Chemicals and Stauffer Chemical Company, in Elkton, Maryland, discharge acid also in unknown quantities. Chemetron has neutralization facilities, but control of the operation is inadequate. Elk Paper Manufacturing Company, in Childs, Maryland, has discharged paper waste and grease in the past, although no discharge has been observed recently [35].

Airco Chemical Division in Elkton, Maryland, discharges a polyvinyl acetate waste without adequate treatment to Bens Gut, a tributary of Big Elk Creek [35]. Equivalent of secondary or higher treatment for organic wastes and adequate neutralization should be provided for the waste discharges cited above. The possibility of a common waste treatment plant for present and prospective industries in the Elkton Industrial Park should be investigated.

The Chesapeake and Delaware Canal, which runs eastward from Elk River through Back Creek and a dug channel to Delaware River, receives partially treated sewage from Imhoff tanks at Chesapeake City, and untreated wastes from the Losten Dairy near Chesapeake City have been observed flowing into a culvert leading toward the Canal. These wastes should receive secondary treatment.

4. Chester River Basin

Chester River rises in Kent and New Castle Counties, Delaware, but receives no known waste discharges in this area [33]. In Maryland, it forms the boundary between Kent and Queen Annes Counties, in which most of its drainage area lies. In Maryland, the River is closed to shellfishing from the head of tide to about

ten miles below Chestertown because of shoreline septic tank leaching and erratic operation of the obsolete Chestertown (population 3,650) sewage treatment plant [4]. Coliform densities in excess of 1,000 MPN per 100 ml have not been experienced [36]. A new lagoon for Chestertown is under construction, and action should be taken by local authorities to correct septic tank malfunctions.

Queenstown, Maryland (population 375), has forced closure of Queenstown Creek to shellfish harvesting because of septic tank leaching [41]. Queenstown plans to build a lagoon for a design population of 600, as proposed by consultants [27]. Queenstown should also be included in the Kent Island-Kent Narrows Area study (see Eastern Bay discussion and special study needs).

Septic tank leaching in Rock Hall, Maryland (average population 1,200), has forced the closing of Rock Hall Harbor to shellfish harvesting [4]. Rock Hall plans to build a lagoon for 1,500 population as proposed by consultants [20]. Current plans are to discharge the treated effluent to Grays Inn Creek.

5. Eastern Bay Drainage

Eastern Bay lies south of the Kent Island-Kent Narrows Area and north of Tilghmans Island. The drainage area lies entirely in Talbot and Queen Annes Counties, Maryland. Principal tributaries are the Miles and Wye Rivers and Prospect Bay.

Septic tank leaching along the rural shoreline area around the Miles River tributaries of Spencers Creek, Little Neck Creek, Newcomb Creek, and Leeds Creek has required closing these waters

to shellfish harvesting. Wye River, Wye East River, Wye Narrows and Skipton Creek are also closed to shellfish harvesting because of septic tank problems along the rural shoreline area[4]. Local authorities should take action to correct the septic tank malfunctions.

Until recently, Miles River was closed in the vicinity of St. Michaels, Maryland, because of buffer zone requirements for the St. Michaels' sewage treatment plant. This area was opened on the condition that adequate plant capacity, control measures, and alarm precautions be provided. Miles River is the only Eastern Shore area where buffer requirements have been relaxed [36].

Kent Narrows, the channel dividing Kent Island from the main part of Queen Annes County, and Cox Creek are closed to shellfish harvesting because of septic tank malfunctions along the shoreline area, which includes the communities of Stevensville, Chester and Grasonville, as well as many marinas [4]. Total population of this area is in excess of 3,000. Sanitary conditions along the shoreline in the Kent Island-Kent Narrows Area are notoriously poor. It is doubtful that these conditions can be corrected by routine septic tank maintenance. A survey should be made in this area, including Queenstown, to investigate conditions thoroughly and to determine the need for public sewers.

6. Choptank River Basin

The Choptank River, largest of the Eastern Shore rivers, is the most valuable of all its oyster waters currently closed by pollution [34]. The River rises in Kent County, Delaware, but most

of its drainage area is in Talbot, Caroline and Dorchester Counties, Maryland. There are no known sources of pollution in the Delaware portion of the Basin [33].

Greensboro (population 1,200) discharges raw sewage into the Choptank River above the head of tide. This discharge is the apparent cause of a median coliform density of 40,000 MPN per 100 ml below Greensboro. The median coliform density is 1,000 MPN per 100 ml at the Town of Choptank (Hunting Creek), about 25 miles downstream from Greensboro [35].

Other discharges contribute to pollution in the upper reaches of the tidewater. The Textron Company, in Denton, discharges poultry processing waste into Choptank River after screening treatment only. Ridgley (population 900) discharges sewage to Tuckahoe Creek about ten miles upstream from Choptank River after some treatment in an obsolete primary plant constructed in 1914. East New Market (population 225) discharges sewage to Warwick River after treatment in a 1939 Imhoff tank plant. Septic tanks in Secretary (population 365) affect the bacterial quality of Warwick River, and there are other rural septic tank problems in the shoreline area and communities in the upper Choptank Basin [36]. Secondary treatment should be provided for the towns cited above and corrective action on shoreline septic tank violations should be taken by local health officers. At present only Secretary, for which a consultant has recommended construction of sewers and a treatment lagoon, has definite plans [28]. Although East New Market and Secretary are only two miles apart, the cost of

transmitting raw sewage between them would probably exceed significantly the cost of providing a separate new treatment plant for East New Market. Consideration might be given, however, to pumping the effluent from East New Market's Imhoff tank to the Secretary lagoon.

Cambridge, Maryland, the largest town in the Choptank Basin and the second largest on the Eastern Shore, discharges about 2.7 mgd of sewage and industrial waste effluent to Choptank River after primary treatment and heavy chlorination[30,31]. Although the population served is 13,000 plus some fringe population, the plant receives an organic load of 52,000 population equivalent because of industrial contributions. Principal industrial waste contributors are the Maryland Tuna Corporation (canned tuna), Chun-King Corporation (Chinese speciality foods), Coastal Foods Corporation, and Western Printing and Lithographing Company. In addition, Coldwater Seafood Corporation, a tuna canning operation, has made definite plans to move to Cambridge. The Cambridge sewage treatment plant needs both secondary treatment capability and additional capacity. Only excellent operation of the Cambridge sewage treatment plant has prevented serious degradation of water quality thus far.

The Choptank is open to shellfish harvesting below the Cambridge buffer zone. Cambridge, because of the massive chlorine dosages applied to the effluent, does not contribute significantly to bacterial contamination except during periods of heavy rainfall. Because of the importance of the potential shellfish harvest in

Choptank River, measures should be taken to avoid closure of shellfish waters for buffer zones. MDWR is currently conducting field surveys to determine water quality in the Cambridge vicinity. Data from earlier surveys above Secretary are now being published.

7. Nanticoke River Basin

The Nanticoke Basin, second largest of the Eastern Shore, is the largest single drainage area in Delaware. The Nanticoke and its larger tributaries, Marshy Hope Creek and Broad Creek, all originate in western Sussex and Kent Counties, Delaware. Slightly less than half the drainage area lies in Maryland, in Caroline, Dorchester and Wicomico Counties. The River is navigable to the head of tide at Seaford, Delaware.

Sewage from the Town of Seaford (population 4,400) receives primary treatment in a modern plant before discharge to the Nanticoke. Secondary treatment should be provided for Seaford wastes to protect and enhance water quality in the receiving stream.

A large nylon manufacturing plant operated by the DuPont Company is located at Seaford. This plant has an enormous pollution potential but in-plant measures and careful waste segregation has limited this plant's effect to an "occasional DO problem."[33] Sludges and concentrates are barged to sea. Game fish pass in water adjacent to the plant in season [32]; apparently neither organic nor thermal discharges interfere seriously with sport fishing. During a 1957 water quality survey by DWARC [1], the minimum dissolved

oxygen concentration measured in Nanticoke River was 3.1 mgd, or 35 per cent saturation. Dissolved oxygen fluctuations characteristic of eutrophic streams were apparent in these data. The DuPont plant has cut back on operation during periods of critical stream conditions to avoid degradation of water quality[33].

On the basis of the program now in effect, it is believed that the DuPont plant management and the DWARC will continue to take action as necessary to maintain water quality in the Nanticoke River. No immediate need was cited for the DuPont plant.

Sharptown, Maryland (population 700), discharges raw sewage just downstream from the Delaware border. This sewage should receive secondary treatment as soon as possible.

Federalsburg, Maryland (population 2,100), located above the head of tide on Marshy Hope Creek, provides secondary treatment for its sewage and wastes from the John N. Wright Company (vegetable cannery) and the Textron Company (chicken processing). Treatment is adequate except during the sweet potato season. Expansion of treatment facilities or industrial pretreatment is an immediate need to prevent a seasonal effect on water quality.

Vienna, Maryland, (population 400), located at the U. S. Route 50 crossing of the Nanticoke, discharges sewage to the river without treatment. Vienna's sewage should receive secondary treatment as soon as possible.

The bacterial quality of Nanticoke River does not become acceptable for shellfish harvesting until Newfoundland Point, a

short distance below Wetipquin Creek [2]. Oyster beds extend several miles above this point. The importance of shellfish in these prohibited waters was not determined during this study, but they are potentially productive. The salinity of these waters is too low to support the MSX virus. There is a productive area below the prohibited area and above the more saline waters of Tangier Sound.

8. Wicomico River Basin

The Wicomico River receives waste from the Salisbury area, the largest and fastest growing area of the Eastern Shore. The drainage area of the Wicomico, which is one of the smaller Eastern Shore rivers, lies principally within Wicomico County; the remainder is in Sussex County, Delaware, and Somerset County, Maryland. Only a few small tributaries feed the Wicomico above Salisbury where the tidal action is stopped by dams.

The Salisbury (population 17,000) sewage treatment plant, a modern trickling filter plant, is of adequate capacity for the population served (about 28,000), but industrial wastes raise the total BOD load to 84,000 population equivalent. A single year-round food manufacturing plant operated by the Campbell Soup Company contributes 27 per cent of the flow, 57 per cent of the BOD load, and 40 per cent of the suspended solids load to the sewage treatment plant. Caustic discharges from the Campbell Soup Company plant also interfere with proper operation.

In spite of excellent operation and a conscientious (often round-the-clock) control program, the plant cannot cope with the load it receives. A study has been made by a consulting engineer, and badly needed plans for plant expansion are being considered by the city[25].

The Salisbury area, however, consists not only of Salisbury, but also of a fringe area outside the incorporated limits and the contiguous unsewered Town of Fruitland (population 2,400). Septic tank leachings and overflows from Fruitland have an adverse effect on water quality, and, in addition, the Green Giant Corporation, Dulany Frozen Foods Division, has a land disposal system which seeps and overflows to Sharps Creek, a small tributary of Wicomico River. A consulting engineer has recommended sewering Fruitland and building a 0.37 mgd trickling filter plant for the town only[22]. Consideration should be given instead to building a plant which would provide both greater economy in unit costs and more flexibility for municipal growth. One alternative would be to provide a new secondary treatment plant to treat Fruitland's sewage, Green Giant's waste (after adequate pre-treatment) and a portion of Salisbury's sewage as required to prevent overloaded conditions from occurring at the existing Salisbury plant. A second alternative would be to expand the existing Salisbury plant to provide secondary treatment for wastes from the sources listed above. Costs given in the summary are for plans as now proposed. This construction, however, should not be undertaken without a review

of the action outlined above and other relevant alternatives. Fruitland is a logical part of the Salisbury metropolitan area, and treatment needs should not be considered limited by political boundaries established when the Towns were separate physical entities.

Waste loads from the Salisbury area may require, even at the existing population level and state of industrial development, BOD removal greater than 85 per cent, advanced waste treatment for nutrient removal, or diversion to an area which will provide more adequate dilution and flushing. Field studies of water quality in the Wicomico are now being conducted by the Chesapeake Field Station, FWPCA.

There are currently no waste discharges to the Wicomico below Salisbury, and no known waste sources below the Fruitland area. Coliform densities between the Salisbury area and Wicomico Creek vary from 1,000 to greater than 2,400 MPN per 100 ml[35]. Wicomico Creek itself has a median coliform density greater than 2,400 MPN per 100 ml. Below Wicomico Creek, the median density is less than 1,000 MPN per 100 ml, and at Mt. Vernon (Buoy 21), bacterial quality of the Wicomico is acceptable for shellfish harvesting. Since oyster beds extend only slightly above Mt. Vernon, interference with the harvest is probably marginal. The salinity of these waters is too low to support the MSX virus, and there are productive oyster grounds between the prohibited zone and Tangier Sound.

The excessive coliform densities are apparently not the result of the Salisbury sewage treatment plant discharge[36]. Fruitland certainly has an adverse effect on river water quality, but unsewered areas downstream are also significant, particularly in Wicomico Creek. Sewering these areas is not practical at this time. Local health authorities should require correction of shoreline septic tank malfunctions.

9. Little Annemessex River

Crisfield, Maryland (population 3,500), discharges sewage after primary treatment to the Little Annemessex within the embayment formed by James Island, where the State of Maryland plans a state park development. Extensive marina facilities have already been constructed at Somers Cove in Crisfield. In view of the extensive water use which this area is expected to receive, Crisfield sewage should receive secondary treatment.

The Town of Crisfield is not entirely sewered nor are fringe areas served. The town is so low in elevation that tidewater floods some streets, and ditches within the Town are known to be contaminated[36]. The Crisfield area should be the subject of a pollution source survey.

10. Pocomoke River Basin

The Pocomoke River originates in lower Sussex County, Delaware. The remainder and by far the largest part of its drainage area lies in Maryland, except for a small area in northern Accomack County, Virginia. Lower reaches of the Pocomoke form the boundary between Worcester and Somerset Counties, Maryland, and between Somerset County and Accomack County, Virginia.

The Pocomoke is a beautiful and interesting river which reminds one more of the bayou country of the Gulf Coast than of the other rivers to the north. It originates and flows through the northernmost cypress swamp in the United States and supports an abundant fish and wildlife population in its waters and marshes. Because its shoreline is predominated by marsh, long reaches of the river remain wild. Large well-kept farms and stately houses occupy the higher land, especially in the lower reaches.

There are no known sources of pollution in the Pocomoke Basin upstream from Snow Hill, Maryland[33,35]. Snow Hill (population 2,400), provides primary treatment for its municipal sewage. Maryland Chicken Processors, Incorporated, operate a very large poultry processing plant in Snow Hill and discharge waste to the Pocomoke River with essentially no treatment. The effect of these wastes on river water quality has not yet been determined, but a nuisance is created by feathers and offal in the river[43]. Snow Hill plans to add an extended aeration treatment plant for the poultry processing waste adjacent to the municipal primary plant[23]. Bids received for this construction in response to recent advertising were 40 to 60 per cent above the consulting engineers' December 1965 cost estimate, and the Town did not let a contract for the work[40], but current indications are that they will go ahead. The Maryland Chicken Processors plant waste is a major pollution source and should receive a minimum of equivalent of secondary treatment.

The W. T. Onley Company, located across the river from Snow Hill, discharges about 0.6 mgd of vegetable canning waste in season after screening treatment only. This waste should receive a minimum of equivalent secondary treatment. Snow Hill should also provide secondary treatment.

Pocomoke City (population 3,400) discharges raw sewage to the Pocomoke River. Three small meat-packing plants and a cannery located in Pocomoke City all discharge raw or inadequately treated wastes to Pocomoke River and are listed in Table I. The Campbell Soup Company is modernizing the old Birdseye food manufacturing plant, a large installation, and will start operation in the near future. Engineering studies were recently completed for a lagoon and interceptor to collect and treat sewage and industrial waste from Pocomoke City[38]. This facility should be constructed as soon as possible.

Pitts Creek originates in Wagram Swamp in Maryland but lies largely in Virginia. Cannery wastes discharged with less than secondary treatment by H. E. Kelley and Company near New Church, Virginia, degrade water quality in a small tributary, although their effect on Pitts Creek is undetermined[42]. This waste should receive equivalent secondary treatment.

The median coliform density in the Pocomoke River is greater than 2,400 MPN per 100 ml below Pocomoke City. The coliform density is generally in the hundreds in the lower reaches, but bacterial quality is not acceptable for shellfish harvesting

downstream to the outer waters of Pocomoke Sound[36]. The waters closed to shellfishing, however, are not important commercially; crabs are the important catch in Pocomoke Sound. Abating the raw sewage discharge from Pocomoke City will, of course, produce immediate improvement in the bacterial quality of Pocomoke River. Bacterial contamination from poultry and livestock farms along the river and upper sound may also be significant, however, and an estimate of their contribution should be made in the course of preparing a pollution source inventory.

VII. INSTITUTIONAL ARRANGEMENTS

In Delaware, the Water and Air Resources Commission (DWARC) has the responsibility for maintaining water quality and a general authority over all waste discharges and treatment facilities. As its name implies, the scope of authority of DWARC is quite broad. The only water-related functions not included in its jurisdiction are shellfish sanitation and review of health aspects of waste treatment, which are under the jurisdiction of the Delaware State Department of Health (DSDH).

Maryland and Virginia institutional arrangements are very much alike. The Maryland Department of Water Resources (MDWR) and Virginia State Water Control Board (VWCB) both have responsibility for maintaining water quality and general authority over industrial waste discharges and treatment facilities in their respective States. Similarly, in both States the MSDH and VSDH have jurisdiction over sewage discharges, treatment plants and shellfish sanitation. The Maryland Department of Chesapeake Bay Affairs (MDCBA) has general jurisdiction in Maryland over the use of the Bay as a resource.

In all three States, county health departments have jurisdiction over local sanitation. Measures to correct unsatisfactory local sanitary conditions are outside the jurisdiction of pollution control agencies, but there are many shoreline areas where these local conditions affect water quality. The problems involved in

the assumption of responsibility for building and operating sewage treatment plants by small towns and industries have been discussed in preceding sections (III and IV). The existing pattern of local government on the Eastern Shore does not lend itself to a near-optimal program of pollution control.

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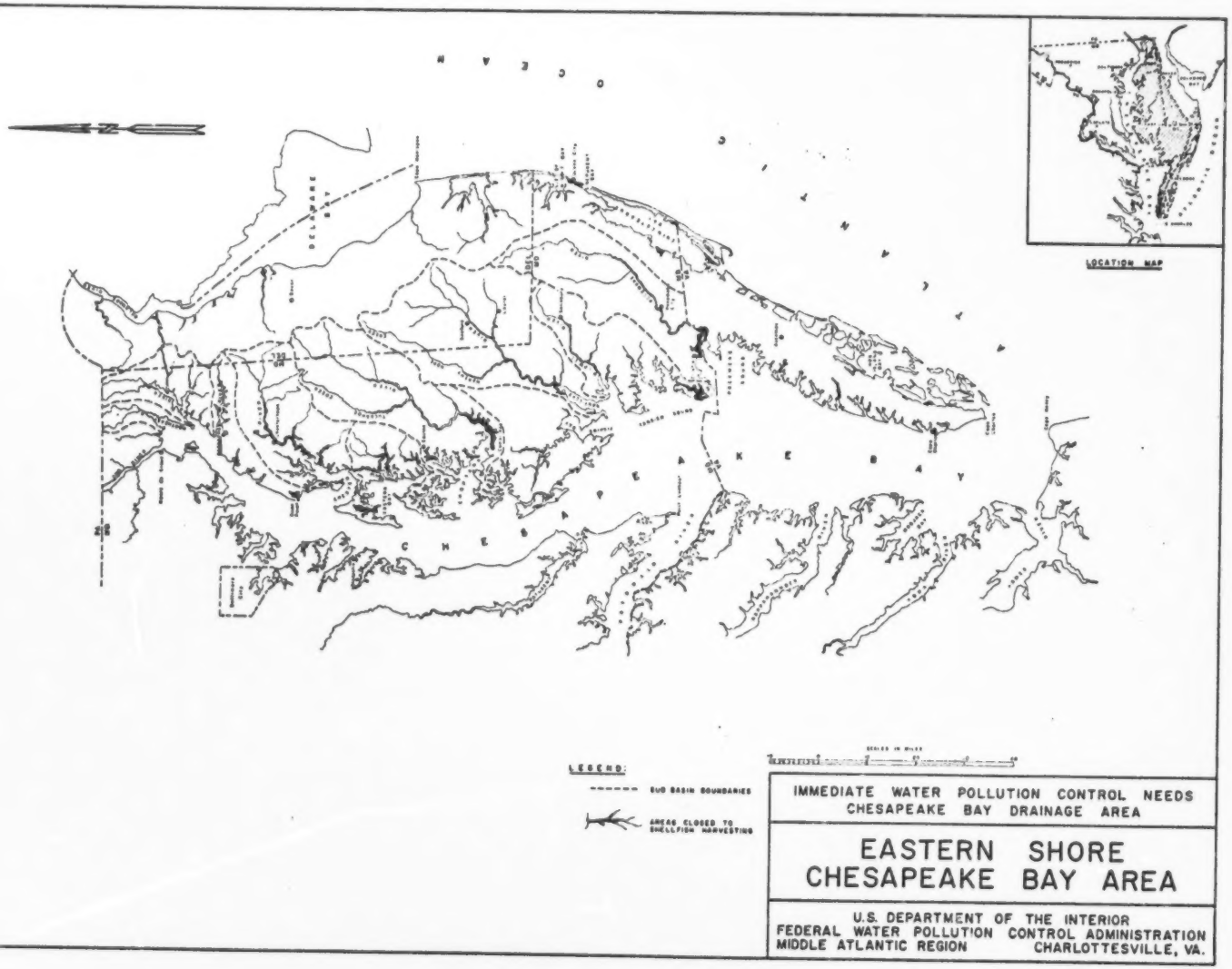
LOCATION MAP
LEGEND:
SUB BASIN BOUNDARIES
AREAS CLOSED TO SHELLFISH HARVESTING
IMMEDIATE WATER POLLUTION CONTROL NEEDS
CHESAPEAKE BAY DRAINAGE AREA
EASTERN SHORE
CHESAPEAKE BAY AREA
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
MIDDLE ATLANTIC REGION
CHARLOTTESVILLE, VA.

FIGURE 1